# United States Department of Agriculture,

## BUREAU OF CHEMISTRY,

H. W. WILEY, *Chief of Bureau.*

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## PRELIMINARY REPORT ON THE UNIFICATION OF TERMS FOR REPORTING ANALYTICAL RESULTS.

(Committee of the Association of Official Agricultural Chemists.)

At the twenty-first meeting of the Association of Official Agricultural Chemists, held in September, 1904, a resolution was adopted, "That a committee of five be appointed to consider the whole question of unifying the terms in which analytical results are reported and report to the association at its next meeting."

The committee has been considering the matter by correspondence during the year and contemplates making recommendations at the next meeting of the association on the subjects of soils, fertilizers, ash, sugars, feeding stuffs, foods, and insecticides. On account of the fact that considerable changes are likely to be made in the methods of examination of dairy products and tannin, recommendations are not made by the committee on these subjects.

In presenting its report at the next meeting of the association the committee desires to represent as fully as possible the ideas of the majority of the members of the association and to place before the association in printed form as many reasons as possible both for and against all recommendations that they may make, and with this in view the report of the committee, so far as it has been prepared, is presented herein, with the request that all who receive it will write in full to the chairman of the committee, Mr. R. J. Davidson, of Blacksburg, Va., and present their opinions regarding the recommendations here presented, and criticise the report in detail.

On all the subjects here discussed, with the exception of soils and ash, the committee are unanimous. On these subjects a considerable difference of opinion has developed, and it has been thought best to give both sides of the question, one of which has been reported by Mr. Hopkins and the other by Mr. Fraps. The expression of members of the association is especially requested regarding the difference of opinion which has developed here.

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C. G. Hopkins, *Urbana, Ill.,*
W. D. Bigelow, *Washington, D. C.,*
G. S. Fraps, *College Station, Tex.,*
C. A. Browne, Jr., *Audubon Park, New Orleans, La.,*
*Committee.*

3501—05

## Soils, Fertilizers, and Ash: Argument for a Uniform Basis of Chemical Elements.

By C. G. Hopkins.

I recommend reporting all analyses, as far as possible, on the uniform basis of chemical elements.

For fertilizers:
- Nitrogen (N).
- Phosphorus (P).
- Potassium (K).

For soils:
- Nitrogen (N).
- Phosphorus (P).
- Potassium (K).
- Calcium (Ca).
- Magnesium (Mg).
- Iron (Fe).

For soils:
- Sulphur (S).
- Inorganic carbon (C).
- Organic carbon (C).
- Aluminum (Al).
- Manganese (Mn).
- Sodium (Na).
- Chlorin (Cl).
- Silicon (Si).
- Insoluble matter.
- Hydrogen and oxygen.

The hydrogen and oxygen may be reported "by difference," or, if desired. they can be computed in the usual manner by calculating the oxygen necessary to form oxids with certain of the determined elements and adding to this the loss in ignition (after deducting the amount of volatile elements determined). Silicon (Si) can be reported if determined separately from the insoluble matter. Of course, in ultimate analyses, by the fusion method, the insoluble matter disappears. It will be seen that there is no difficulty whatever in reporting soil analyses by this method. This has already been demonstrated and illustrated by the Ohio experiment station.[a]

In considering the different forms of nitrogen we can report nitrate nitrogen, ammonia nitrogen, and organic nitrogen; and, if necessary, we can also distinguish between organic and inorganic sulphur and between organic and inorganic phosphorus, as we do between organic and inorganic carbon. A complete analysis of potassium chlorid would be reported:

| | Per cent. |
|---|---|
| Potassium | 52 |
| Chlorin | 48 |
| Total | 100 |

Whereas under the old system we have:

| | Per cent. |
|---|---|
| Potash ($K_2O$) | 63 |
| Chlorin (Cl) | 48 |
| Total | 113 |
| Less oxygen replaced by chlorin | 13 |
| | 100 |

One of the reasons for adopting this system is to secure ultimate uniformity. At the present time there is no uniformity.

*Nitrogen.*—A majority of the States already report nitrogen as N, but several States report it as $NH_3$, and the Bureau of Soils reports it as $NO_3$. $NH_3$, and N.

*Phosphorus.*—The Bureau of Soils reports phosphorus as $PO_4$, $P_2O_5$, or P. Illinois reports it as P, and all other States as $P_2O_5$.

[a] Ohio Bul. No. 150, p. 131, "Ohio Soil Studies."

*Potassium.*—The Bureau of Soils and the State of Illinois report potassium as K, and all other States, also the Bureau of Soils, report it as $K_2O$.

I especially desire to call the attention of the committee to the fact that with few exceptions the various State laws permit the use of "equivalents" in addition to the required statement of analysis. Thus a uniform statement giving both N and $NH_3$, P and $P_2O_5$, K and $K_2O$ could be used by all manufacturers, and it would be acceptable in almost every State under the present laws. If this double statement were prepared in the simplest form it would not be objectionable, and it would not require any immediate or special legislation, excepting in one or two States. I would suggest the following form:

| | Per cent. | | Per cent. |
|---|---|---|---|
| Nitrogen | 1.4 | Ammonia | 1.7 |
| Available phosphorus | 6.4 | Available phosphoric acid | 14.4 |
| Insoluble phosphorus | 0.6 | Insoluble phosphoric acid | 1.4 |
| Total phosphorus | 7.0 | Total phosphoric acid | 15.8 |
| Potassium | 3.9 | Potash | 4.7 |

In personal conference with some leading members of the Fertilizer Manufacturers Association I have been assured that they would be very glad to adopt such a uniform statement of analysis as this if it would be accepted in all States.

If this were encouraged by agricultural experiment stations it could readily be brought about, and it would make a very easy transition from the old system of nomenclature to the system using the simple basis of chemical elements. This would apply not only to the manufacturers and to their literature, but also to experiment station literature and to the farmers who use fertilizers and read bulletins. In the course of a few years the use of the old system would gradually cease.

It should be remembered that most fertilizer bulletins are out of date and of little value twelve months after they are issued, and with proper encouragement the writers of such bulletins would soon be using only the chemical elements.

It is already practically certain that the term ammonia will never be adopted by all States, and it is doubtful if entire uniformity will ever be reached on any other basis than the simplest one—namely, the basis of chemical elements.

I venture the opinion that any farmer who has already mastered our complex system will very readily understand the simpler system, and that the vast majority of such farmers will encourage and welcome the change. Certainly if the double system be used for a time they will have no difficulty.

Shall we compel the American farmer for all time to try to understand why he must buy potassium (K) on the basis of $K_2O$ in potassium chlorid (KCl), and why he must buy phosphorus (P) on the basis of $P_2O_5$ (falsely so-called phosphoric acid) when he needs the element phosphorus?

It is now within the power of these committees and the associations represented to bring about this simpler system. Our opportunity and our responsibility are at least as great and the task no greater than the overthrow of the English money system and the adoption of the decimal money system by our forefathers, an action and an example which have since been followed by every civilized nation, save England herself.

Shall we be compelled to recalculate or to have some clerk or assistant to recalculate the analytical data from a few bulletins and journals in order to make comparisons with future publications, or shall we compel several million American farmers in every future generation to try to understand an unnecessarily complicated system of nomenclature pertaining directly and almost solely to the science and profession of agriculture?

The same system of nomenclature to be adopted for soils should be used for all farm produce when analyzed with reference to plant-food elements, as well as for fertilizers and manures and for drainage and irrigation waters.

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## Objections to the "Element" System of Nomenclature.

By G. S. Fraps.

1. The proposed system is used by one State; the present system is used by all other States and Germany, France, Japan, England, and other foreign countries. The adoption of the proposed system will produce confusion among the States, and, even if adopted by all States, lack of uniformity between the United States and foreign countries would result.
2. The present system is incorporated in the fertilizer laws of twenty-seven States. Any change would require legislative action in all these States, ultimately, if not immediately.
3. A change in the terms used will cause confusion in the minds of the multitude of farmers, manufacturers, and dealers, who are acquainted with the terms now in use.
4. The apparent decrease of 20 per cent in potash and 50 per cent in phosphoric acid caused by the new system would require an immense amount of explanation.
5. The use of a double system for fertilizers to introduce the new system is undesirable, as it would result in confusion. The same objections apply as to the use of bone phosphate of lime in place of phosphoric acid.
6. In soil work a great amount of calculation would be required before the results by the new method could be compared with the analyses made in the past, all of which are stated in terms of the present system.
7. The proposed system does not save time in calculation, express results more clearly, nor is it more simple so far as the writer can see.

Instead of the system proposed by Mr. Hopkins, the following nomenclature is recommended by the other members of the committee:

### Nomenclature Proposed, Based on System Now in Use.

#### FERTILIZERS.

| | |
|---|---|
| Nitrogen (N). | Potash ($K_2O$). |
| Phosphoric-acid ($P_2O_5$). | |

#### SOILS.

| | |
|---|---|
| Insoluble matter. | Active potash. |
| Soluble silica ($SiO_2$). | Phosphoric acid ($P_2O_5$). |
| Potash ($K_2O$). | Sulphur trioxid ($SO_3$). |
| Soda ($Na_2O$). | Carbon dioxid ($CO_2$). |
| Lime (CaO). | Water and organic matter. |
| Magnesia (MgO). | Humus. |
| Manganese oxid (MnO). | Total organic matter. |
| Ferric oxid ($Fe_2O_3$). | Nitrogen. |
| Alumina ($Al_2O_3$). | Humus phosphoric acid. |
| Active phosphoric acid (method stated). | Humus potash. |

Humus refers to the organic matter soluble in ammonia. Active phosphoric acid and potash refer to these bodies as dissolved by weak solvents.

## Unanimous Recommendations of the Committee.

### Cattle Feeds.

The nomenclature followed by the International Commission on the Analysis of Feeds at the Congress of Applied Chemistry, in Berlin, 1903, should be adhered to as closely as possible. Nearly all chemists in this country seem agreed as to the following terms:

Crude protein = total nitrogen × 6.25.

Albuminoid or pure protein = albuminoid nitrogen × 6.25 (method of Stutzer or Kellner, whichever used to be specified).

Digestible protein. (The method of artificial digestion or by experiment with animal, the same to be indicated.)

Crude fat or other extract.

Ash.

Regarding the terms fiber, crude fiber, cellulose, nitrogen-free extract, carbohydrates, and lignin some confusion exists and chemists are not in abosolute agreement as to the exact meaning of the several expressions.

*Fiber.*—It seems desirable that this term should be limited to the woody matter, as it is separated from plant tissues without the customary acid and alkaline treatment. The water-insoluble matter (marc) of sugar beets, sugar cane, sorghum, fruits, etc., is an example of the proper application of the term "fiber."

*Crude fiber.*—As usually understood this term is applied to the impure cellulose which results from the chemical treatment of plant tissues, such as is obtained by the Weende process or by the method of König (method to be specified). Crude fiber is often confused with fiber or marc, and for this reason the term "crude cellulose," as employed by the French chemists, is greatly preferable, the only objection being that our present terminology is too firmly established.

*Cellulose.*—This term should be applied only to cellulose in a comparatively pure form, such as is obtained by the method of Cross and Beven, Lange's process, etc. (Indicate method used.)

*Nitrogen-free extract.*—This, according to general usage, is the designation of the undetermined residue (starch, sugars, pentosans, lignin, organic acids, etc.) in a feed analysis. The expression is a cumbersome one, and yet it has come to have such a well-defined meaning that it can hardly be improved upon. The expression "carbohydrates," sometimes employed in place of nitrogen-free extract, is less accurate, since the crude fiber is also largely made up of carbohydrates. "Carbohydrate extract" has been proposed as a substitute, but here again arises an objection, also applicable to the term "carbohydrate," that the lignin bodies which are also largely extracted in the estimation of crude fiber, do not belong to the carbohydrate group, which includes only such bodies as celluloses, hemicelluloses, sugars, starches, etc.

*Lignin or lignin bodies.*—This term, owing to the lack of our knowledge concerning the exact chemical nature of lignin, has been applied indiscriminately to all fiber constituents not cellulose. The lignin bodies are distinguished from other fiber constituents (cellulose and hemicelluloses) by their solubility in alcoholic sodium or potassium hydrate, their capacity for forming chlorination and sulphination products, and their inability to yield reducing sugars on hydrolysis with sulphuric or hydrochloric acids. The terms "lignin" and "lignin bodies" should, therefore, be restricted to the noncarbohydrate matter of vegetable fiber.

The form for reporting on cattle feeds would read as follows:

*Cattle feeds.*

| | Per cent. | | Per cent. |
|---|---|---|---|
| Moisture | | Sucrose | |
| Ash | | Reducing sugars (as dextrose) | |
| Crude protein ($N \times 6.25$) | | Crude fat | |
| Pure protein | | Nitrogen-free extract | |
| Amido bodies | | Total | |
| Crude fiber | | Total nitrogen | |
| Cellulose | | Protein nitrogen | |
| Pentosans | | Amido nitrogen | |
| Starch | | | |

## Foods.

### GENERAL CONSIDERATIONS.

First. It is recommended that wherever practicable specific gravity be stated at a temperature of 20° or 25° C. It is the opinion of the committee that the former temperature is preferable. At present the custom varies, 15°, 15.6°, and 17.5° being used for different substances. It is recommended that a definite temperature (say, 20° C.) be adopted, and that the official tables of the association be recalculated so as to be adapted to that temperature.

Second. It is recommended that acidity and alkalinity of all products and of the ash of those products be expressed in terms of the number of cubic centimeters of normal alkali or acid necessary to neutralize 100 grams (or cubic centimeters) of the substance or of its ash, using phenol-phthalein as indicator.

Note.—The following objection has been made to this recommendation: Regarding the expression of acidity and alkalinity in terms of cubic centimeters required to neutralize 100 grams of the substance, I can hardly see how this can be put into effect because of the numerous State laws requiring acidity to be stated in per cent by weight. The chemists connected with the food control of the various States will have more occasion to use these forms than anyone else, and they not only have to follow the statutes governing the various products, but they have to deal almost entirely with men (commissioners, inspectors, jurors, manufacturers, etc.) to whom statements in the form of cubic centimeters per 100 grams would convey no meaning at all, while the form of per cent is readily understood.

Third. It is recommended that whenever possible the composition of a substance be given in the following order. In the case of substances in which certain characteristic determinations are necessary, such as alcohol in wine, it is suggested that such determinations precede those given below. Order suggested:

Water (solids).

Ash: Various results obtained in the examination of the ash are to be stated in the manner in which they are expressed in the methods of the association for the analysis of ash.

Crude protein ($N \times 6.25$).

Pure protein: Various results obtained in the examination of protein in the order in which they are expressed in the methods of the association for the examination of meat products.

Crude fiber.

Pentosans.

Carbohydrates: Various results obtained in the examination of carbohydrates in the order in which they are expressed in the methods of the association for the examination of cereal products.

Ether extract or crude fat.
Undetermined.

Expressions of opinion are invited as to whether the results in certain liquids should be reported in terms of per cent or of grams per 100 cc. If expressed as grams per 100 cc great care must be taken in measuring the sample, owing to the viscosity of many liquid foods. In case of liquids having a high degree of viscosity it will often be necessary to weigh the portions taken for analysis and calculate the results to the basis of grams per 100 cc. Usually, however, where the viscosity is so great as to preclude the use of a pipette or burette a flask (graduated to deliver) may be employed for measuring the sample, and the portion of liquid adhering to the flask washed out with water. In general, it may be said that with liquids whose viscosity is not great and with those of which samples may be measured in graduated flasks the expression of the analysis in terms of grams per 100 cc has the advantage of saving the analyst considerable calculation and consequently considerable time and chance of error. Moreover, this means of expressing the results has value, in fact is almost essential, in studying certain changes that occur in the preparation of foods, such as in the fermentation of wine and vinegar. The present tendency in the examination of wine and similar products seems to be toward the expression of results in terms of grams per 100 cc. The greater part of the literature of European countries relative to wines and similar products is now expressed in terms of grams per 100 cc and for the purpose of comparison it is of considerable importance to observe the same terms in this country. On the other hand, the argument offered in regard to reporting acidity (p. 6) applies also to this case, and in the case of sirups, vinegar, oil, and many other liquids, when examined for the purpose of judging of the quality or purity, results are universally expressed as per cent by weight.

It is not expected that all of the determinations enumerated below can always be made. It is recommended, however, that those that are made be reported in the manner and order here given.

## COLORS.

Owing to the nature of this subject, it is impossible to express results in tabular form, and there appears to be little that can be said regarding nomenclature. The committee has only to suggest that analysts should guard carefully against the use of trade names in their reports. Wherever any attempt is made to designate an individual color, care should be taken that the color be designated in such a manner that its identity is unmistakable. For this purpose the classification of Schultz and Julius, with the numbers adopted by them, is recommended.

## SACCHARINE PRODUCTS.

It is recommended that the following scheme be employed for expressing results obtained in the examination of saccharine products:

Total solids.
Soluble solids.
Ash, total:
- Alkalinity as cubic centimeters normal acid required per 100 grams of sample.
- Sulphates as $SO_3$, per cent.
- Chlorids as Cl, per cent.

Acidity as cubic centimeters normal alkali per 100 grams.
Crude protein ($N \times 6.25$), per cent.

Crude fiber, per cent.
Carbohydrates:
- Starch, per cent.
- Dextrin, per cent.
- Sucrose, per cent.
- Reducing sugar as dextrose, per cent.
- Polarization, direct, degrees.
- Polarization, invert, degrees.
- Polarization, temperature of, °C.

Ether extract, per cent.
Undetermined, per cent.

### FRUIT PRODUCTS.

Special attention is called to the manner in which total sugar shall be designated. The customs of different analysts vary in this manner. It is the opinion of the committee that a uniform custom is not practicable. If a given analysis is to stand by itself and the total sugar is only desirable as one of the known constituents which are to be added together and subtracted from 100 per cent to secure the percentage of undetermined matter, total sugar should undoubtedly be calculated as sucrose + invert sugar. On the other hand, if the analysis is connected with the study of the change of sugar in any way, such as the manufacture of vinegar or a study of the ripening of fruit, it becomes important to compare the total amount of carbohydrate expressed in a uniform manner at various stages of the process of manufacture, or of the life history of the product. This can only be done intelligently by expressing total sugar in terms of invert sugar.

Attention is also called to the item "reducing sugar as invert sugar." It is now customary to calculate reducing sugar as dextrose, no matter what method of determination has been employed and no matter what the nature of the product examined. For instance, in most of the published analyses of fruit products, reducing sugars are expressed in terms of dextrose. This method of expressing results is altogether incorrect and seems to have nothing to recommend it. Moreover, the results are usually obtained by a method intended only for the determination of dextrose, and consequently are incorrect. The committee therefore considers it important that in the examination of those products whose reducing sugar consists chiefly of invert sugar the methods employed should be those adapted to the determination of invert sugar, and the results should be expressed in terms of invert sugar.

It is recommended that the following scheme be employed for expressing results obtained in the examination of fruit products:

Total solids, per cent.
Insoluble solids, per cent.
Ash, total, per cent.
- Alkalinity, as cubic centimeters normal acid per 100 grams of sample.
- Sulphuric acid, as $SO_3$, per cent.
- Chlorin, per cent.

Acidity, total, as cubic centimeters normal alkali per 100 grams.
Acidity, fixed, as cubic centimeters normal alkali per 100 grams.
Acidity, volatile, as cubic centimeters normal alkali per 100 grams.
Crude protein ($N \times 6.25$), per cent.
- Proteids, per cent.
- Amids, per cent.

Carbohydrates:
- Starch, per cent.
- Total sugar (as invert sugar, or as sucrose + invert sugar), per cent.
- Sucrose, per cent.
- Reducing sugar as invert, per cent.

Pectin bodies, per cent.
Undetermined, per cent.

## WINE.

In the analysis of musts, which are to be used in comparison with the analyses of wines prepared from them, total sugar should be expressed in terms of invert sugar. The scheme recommended by the committee for reporting results of wine analyses is as follows:

Specific gravity.
Alcohol, per cent by volume.
Alcohol, grams per 100 cc (or per cent by weight).
Glycerol, grams per 100 cc (or per cent by weight).
Glycerol-alcohol ratio.
Extract, grams per 100 cc (or per cent by weight).
Ash, grams per 100 cc (or per cent by weight).
- Alkalinity, cubic centimeters N/10 alkali in 100 cc.
- Sulphates, as $K_2SO_4$, grams in 100 cc.
- Phosphoric acid, grams $P_2O_5$ in 100 cc.

Extract ash ratio.
Acidity, total, as tartaric, grams per 100 cc (or per cent by weight).
Acidity, fixed, as tartaric, grams per 100 cc (or per cent by weight).
Acidity, volatile, as acetic, grams per 100 cc (or per cent by weight).
Tartaric acid, grams per 100 cc (or per cent by weight).
Crude protein ($N \times 6.25$), grams per 100 cc (or per cent by weight).
Sugar total (sucrose + invert sugar), grams per 100 cc (or per cent by weight).
- Sucrose, grams per 100 cc (or per cent by weight).
- Reducing sugar as invert, grams per 100 cc (or per cent by weight).
- Polarization direct, degrees.
- Polarization invert, degrees.
- Polarization, temperature of, °C.

Tannin, grams per 100 cc (or per cent by weight).
Color.
Preservatives, milligrams per liter.

## BEER.

The members of the association have not undertaken any work relating to the changes occurring in the manufacture of beer from wort. If such a study were made it would doubtless be more convenient to express all results in terms of grams per 100 cc. Under existing circumstances it is probably better to express results in terms of per cent by weight. The scheme recommended by the committee for reporting the results of beer analysis is as follows:

Specific gravity.
Alcohol, per cent by volume.
Alcohol, per cent by weight.
Glycerol, per cent by weight.
Extract, per cent.

Specific gravity of original wort.
Extract in original wort, per cent.
Degree of fermentation.
Ash, per cent. (Composition of ash in order of determinations under wine analyses.)
Acidity, total as lactic acid, per cent.
Acidity, total as cubic centimeters normal alkali per 100 grams.
Acidity, carbon dioxid, per cent by weight.
Crude protein ($N \times 6.25$), per cent by weight.
Dextrin, per cent by weight.
Sugars total, per cent by weight.
  Maltose, per cent by weight.
  Dextrose, per cent by weight.
  Polarization direct, degrees Schmidt and Haensch in a 200 mm tube (undiluted material).
  Polarization invert, degrees Schmidt and Haensch in a 200 mm tube (undiluted material).
  Polarization at 86° C, degrees Schmidt and Haensch in a 200 mm tube (undiluted material).
Preservatives, milligrams per 100 grams.

DISTILLED LIQUORS.

Specific gravity.
Alcohol, per cent by volume.
Alcohol, per cent by weight.
Extract, per cent.
Ash, per cent.
Acidity, cubic centimeters normal alkali per 100 grams.
Sugar invert, per cent.
Fusel oil, as amyl alcohol, per cent by volume.
Aldehydes, as acetic aldehyde, per cent by weight.
Esters, as ethyl ester, per cent by weight.
Furfurol, per cent.
Coloring matter.

VINEGAR.

Specific gravity.
Alcohol, per cent by weight.
Glycerol, per cent by weight.
Extract (sugar free), per cent.
Ash total, per cent.
  Alkalinity, in terms of cubic centimeters N/10 alkali in 100 grams of sample.
  Phosphoric acid ($P_2O_5$), per cent by weight.
Acidity:
  Total as acetic, per cent.
  Fixed as malic, per cent.
  Volatile as acetic, per cent.
  Mineral acids.
Crude protein ($N \times 6.25$), per cent.
Sugars as invert, per cent.
  Polarizations.
Color.
Qualitative tests.

### FLAVORING EXTRACTS.

The different extracts included under this heading are quite diversified in their nature and it is somewhat difficult to suggest a general scheme that will be applicable to all. The following scheme is suggested by the committee for that purpose:

Specific gravity.
Alcohol, per cent by weight.
Glycerol, per cent by weight.
Characteristic flavoring materials:
  Lemon oil, per cent by weight.
  Vanillin, per cent.
  Coumarin, per cent.
Solids, per cent.
Ash, per cent.
  Alkalinity, as cubic centimeters N/10 alkali in 100 grams of sample.
Acidity, as cubic centimeters N/10 alkali in 100 grams.
Sucrose (or other carbohydrate bodies).
Special tests for methyl alcohol, coloring matter, resins, etc.

### SPICES.

Water (or solids), per cent.
  Solids soluble in water, per cent.
  Solids soluble in alcohol, per cent.
Ash, total, per cent.
  Sand, per cent of original sample.
  Soluble ash, per cent of original sample.
  Lime, per cent of original sample.
Nitrogen, per cent.
  Piperin (nitrogen of ether extract $\times$ 20.36), per cent.
Crude fiber, per cent.
Starch by direct inversion, per cent.
Starch by diastase method, per cent.
Tannin, per cent.
Total sulphur, per cent.
Carbon dioxid (in limed spices), per cent.
Ether extract, total, per cent.
Ether extract, volatile, per cent.
Microscopical examination.

### BAKING POWDER AND BAKING CHEMICALS.

Ash, per cent.
Ferric oxid ($Fe_2O_3$), per cent of original sample.
Aluminum oxid ($Al_2O_3$), per cent of original sample.
Lime (CaO), per cent of original sample.
Potash ($K_2O$), per cent of original sample.
Soda ($Na_2O$), per cent of original sample.
Phosphoric acid ($P_2O_5$), per cent of original sample.
Sulphuric acid ($SO_3$), per cent of original sample.

(This order of the results of the examination of the ash in baking powders should be made identical with that adopted by the association for expressing results of the examination of ash.)

Acids, as tartaric, per cent.
Carbon dioxid, total, per cent.
Carbon dioxid, available, per cent.
Carbon dioxid, residual, per cent.
Starch, per cent.
Polarization.

### MEAT AND FISH.

Water (or solids), per cent.
Ash, per cent.
    Various constituents of ash in order given under ash analysis.
Acidity, as cubic centimeters normal alkali per 100 grams.
Acidity, as lactic acid, per cent.
Crude protein ($N \times 6.25$), per cent.
    Coagulated proteids, per cent.
    Albumin, globulins, and syntonin, per cent.
    Albumoses, per cent.
    Peptones, per cent.
    Gelatin, per cent.
    Meat bases, per cent.
Carbohydrates, per cent.
    Starch, per cent.
    Glycogen, per cent.
    Reducing sugar, per cent.
Ether extract, per cent.
Undetermined, per cent.

### FATS AND OILS.

Specific gravity at 20° or 100° C.
Index of refraction at 20° C.
Melting point of fat, °C.
Melting point of fatty acids, °C.
Titer, °C.
Viscosity.
Microscopic examination.
Saponification value.
Halogen absorption.
Iodin absorption of liquid acids.
Iodin absorption of oil.
Reichert-Meissl value.
Hehner value.
Thermal reactions:
    Bromin.
    Sulphuric acid.
Free acids.
Unsaponifiable matter.
Qualitative tests.

### DAIRY PRODUCTS.

(*a*) Milk and cream.
Specific gravity.
Solids, per cent.
Ash, per cent.
Acidity as cubic centimeters normal alkali per 100 grams.

Crude protein ($N \times 6.25$), per cent.
Milk sugar, per cent.
Ether extract. (Report as under fats and oils.)
Coloring matter.
Preservatives in terms of milligrams per kilogram.
Undetermined.

(*b*) Butter and cheese.
Total solids (or water), per cent.
Ash, per cent.
Acidity as cubic centimeters of normal alkali per 100 grams.
Protein ($N \times 6.25$), per cent.
Carbohydrates, per cent.
Ether extract, per cent. (Examination of fat as directed under oils and fats.)
Undetermined, per cent.

### CEREAL PRODUCTS.

Solids (or water), per cent.
Soluble solids, per cent.
Ash total, per cent.
Alkalinity as cubic centimeters normal acid required per 100 grams.
Acidity as cubic centimeters normal alkali per 100 grams.
Crude protein ($N \times 6.25$), per cent.
- Proteids, per cent.
- Amido bodies, per cent.

Fiber, per cent.
Carbohydrates.
- Starch, per cent.
- Sucrose, per cent.
- Reducing sugar as dextrose, per cent.

Ether extract, per cent.
Undetermined, per cent.

### INFANTS' AND INVALIDS' FOODS.

Same as cereal products.

This does not include that class of invalid foods characterized by high nitrogen content which belongs properly either among the meat products or under dairy products according to their source.

### VEGETABLES.

Same as fruit products.

### CONDIMENTS OTHER THAN SPICES.

Same as fruit products.

### COCOA AND COCOA PRODUCTS.

Solids (or water), per cent.
Ash, total, per cent.
- Sand, per cent.
- Alkalinity as cubic centimeters normal alkali per 100 grams of cocoa present.

Crude protein (N×6.25), per cent.

Theobromin and caffein, per cent.

Crude fiber, per cent.

Starch by direct inversion, per cent.

Starch by diastase method, per cent.

Sugar, per cent.

Ether extract, per cent.

Index of refraction, iodin number, and melting point in order given under fats and oils.

Undetermined, per cent.

Microscopic examination.

COFFEE.

Solids (or water), per cent.

Soluble solids, per cent.

Ash total, per cent.

Water soluble, per cent.

Sand, per cent.

Chlorin, per cent.

Alkalinity in terms of cubic centimeters normal acid per 100 grams of coffee.

Crude protein (N×6.25), per cent.

Caffein, per cent.

Crude fiber, per cent.

Starch by direct inversion, per cent.

Starch by diastase method, per cent.

Sucrose, per cent.

Reducing sugars as dextrose, per cent.

Ether extract, per cent.

Tannic acid, per cent.

## Sugar.

The scientific nomenclature proposed by Fischer should be followed wherever possible, the only important exceptions, perhaps, being in the case of the terms "glucose" and "fructose." "Glucose" in this country has been applied indiscriminately to dextrose (starch-sugar), reducing sugars in general, and to the commercial glucose prepared from starch, thus causing much confusion. The term "dextrose" is long established and leads to no misunderstanding. The word "glucose" would thus be applied only to the commercial preparation, except in the case of long established technical expressions, such as "glucose ratio."

*Levulose.*—This is the term in most common use among chemists in this country, being preferred to "fructose." The latter, though, seems to be preferred by the English chemists.

*Reducing sugars.*—This term comprises all sugars which reduce Fehling's solution (dextrose, levulose, galactose, xylose, etc.). While the exact character of such sugars is unknown, the expression "reducing sugars" is to be used, always stating in terms of what sugar the analysis is expressed: Reducing sugars as dextrose, reducing sugars as levulose, etc.

*Invert sugar.*—This term should be applied only to the mixture of dextrose and levulose in equal proportions, such as is obtained by the inversion of sucrose.

*Sucrose.*—This term is preferable to "cane sugar." The latter expression often produces confusion, as in the query which occasionally is made, "Why is it that pure maple sirup or beet molasses contains cane sugar?" Reducing the other sugars, raffinose, maltose, lactose, xylose, etc., the usual nomenclature is followed.

In the nomenclature of the hemicelluloses or gums the usual terminology is followed:

Pentosans ______ { Xylan,
Araban, etc.

Hexosans ______ { Galactan,
Dextran,
Mannan,
Levulan,
Cellulan, etc.

A difference prevails among English-speaking chemists as to the proper terminology of the alcohol derivatives of the sugars, some preferring the ending "ite," as mannite, dulcite, sorbite, arabite, etc., and others using the termination "itol," as mannitol. The former nomenclature seems preferable, as it is shorter and is more in accordance with Continental usage.

## Insecticides.

The two principal insecticides to be considered under this heading are Paris Green and London Purple. In making complete analyses of Paris Greens the following constituents should be determined: Moisture, sand, sulphur trioxid, copper, total arsenic, soluble arsenic, and acetic acid.

It is best to report the sulphur trioxid in the form of sodium sulphate, since, from the method of manufacture of Paris Green, it is almost certain that the sulphur trioxid exists in this form in the Green. The copper should be reported as so much cupric oxid ($CuO$), and the total arsenic as so much arsenic trioxid or arsenious oxid. The acetic acid present should not be reported as acetic acid, as is usually done, but as acetic anhydrid, since the reporting of the copper as cupric oxid has left the acetic acid as acetic anhydrid.

In reporting soluble arsenic it should be reported as so much arsenious oxid or arsenic trioxid and should be determined in two ways: First, by the Avery-Beans method, to approximately determine the actual free arsenious oxid present; and, second, by the prolonged water-soluble method, to determine to some extent the stability of the Green.

In examining samples of London Purple the following determinations should be made: Moisture, insoluble in hydrochloric acid, total and soluble *ic* arsenic, total and soluble *ous* arsenic, calcium, and dye by difference. The *ic* arsenic in both cases should be reported as arsenic pentoxid and the *ous* arsenic as arsenic trioxid. The calcium should be reported as calcium oxid. The words "by difference" should always follow the dye figure.

*Form of reporting results of analyses.*

PARIS GREEN.

| | Per cent. |
|---|---|
| Moisture | |
| Sand | |
| Sodium sulphate | |
| Total arsenious oxid | |
| Total copper oxid | |
| Acetic anhydrid | |
| Total | |
| Soluble arsenious oxid by Avery-Beans method | |
| Soluble arsenious oxid by water-extraction method | |

LONDON PURPLE.

| | |
|---|---|
| Moisture | |
| Insoluble in hydrochloric acid | |
| Total arsenic oxid | |
| Total arsenious oxid | |
| Calcium oxid | |
| Dye (by difference) | |
| Total | |
| Soluble arsenic oxid | |
| Soluble arsenious oxid | |
| Soluble calcium oxid | |

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